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ABSTRACT

This handbook is intended to assist in the assessment and refinement of teacher preparation for industrial technology education in Texas. The first section contains preliminary information on the significance, development, and use of the guidebook. Provided next is an industrial technology teacher preparation assessment instrument that is based on a national survey of model or exemplary industrial technology teacher preparation programs. The next section contains a second industrial teacher preparation assessment instrument, which was developed for a three-round Delphi study. The fourth and final section consists of suggested recommendations for program improvement that were written with the following considerations in mind: essential elements, special needs students, equal access, and appropriate computer applications. Extensive appendixes include an instrument for assessing model field experience programs, survey results of model industrial technology field experience programs, statements characterizing a model industrial technology field experience, essential elements for introductory industrial technology courses at different levels, and membership lists of various panels and committees connected with developing the materials and methods used in the guidebook. (MN)

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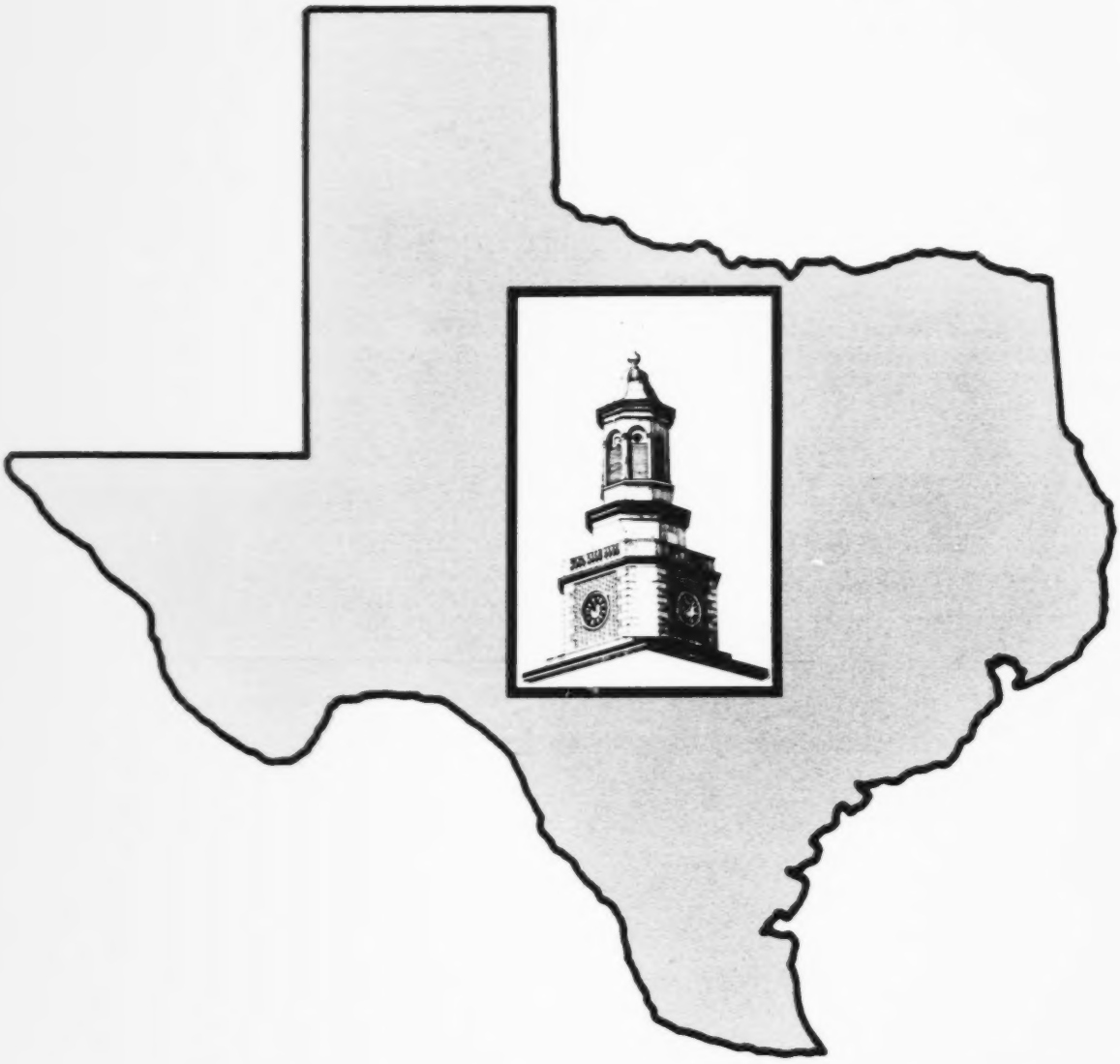
GUIDEBOOK

FOR
INDUSTRIAL TECHNOLOGY
TEACHER PREPARATION FIELD EXPERIENCE



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GUIDEBOOK FOR INDUSTRIAL TECHNOLOGY TEACHER PREPARATION FIELD EXPERIENCE

Project No. 84-178

Assessment of Industrial Arts Field Experiences

A Research Project in
Vocational Education

Conducted Under
Public Law 94-482, title II

Funded by the
Research Coordinating Unit
Department of Occupational Education and Technology
Texas Education Agency

Phillip R. Foster
Michael R. Kozak
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Division of Industrial Technology
North Texas State University
Denton, Texas

June 30, 1985

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Admission to North Texas State University and any of its sponsored programs is open to qualified individuals regardless of race, color, religion, sex, national origin or educationally-unrelated handicaps.

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The Material Validation and Review Committee included: Neil Ballard, Marty Barbieri, Donna Cunningham, Nelda Evarts, Ron McQueen, James L. Poirot, Paul Schlieve and Judy Stewart.

Secretarial staff consisted of Millicent Jones, Salesta McAvoy, and Rebecca Millican. Without their dedication, it would have been impossible to produce the required materials during the project.

Last but certainly not least, appreciation is also expressed to Paul W. Lindsey, Associate Commissioner for Occupational Education and Technology; Luther W. Thompson, Jr., Director, Occupational Administrative Services; Dan Bristow, Director, Research Coordinating Unit; and Patricia F. Lindley, Educational Program Director.

The results of the project will hopefully have considerable impact on the industrial technology* teaching profession in the state of Texas. The Final Report and the Guide Book are to be distributed to the Research Coordinating Unit, members of the Advisory Committee, members of the Delphi Panel, and members of the Material Validation and Review Committee. Copies of the Guide Book will be forwarded to individuals responsible for the supervision of industrial technology field experiences at each of the fifteen Texas institutions that have such teacher training programs. The Final Report and the Guide Book will also be cross referenced in the ERIC system.

Phillip R. Foster
Michael R. Kozak

*"Industrial technology" is substituted for "industrial arts" throughout this report, whenever possible. This reflects a national trend.

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SECTION I
INTRODUCTION

Industrial Technology Education in the state of Texas is currently undergoing significant changes ranging from curricular content to teacher preparation. These changes are engineered to update and align the profession with the finer thinking in the field. A very important aspect of industrial technology education is the method and manner in which teachers are prepared for classroom duty. This encompasses a wide spectrum of responsibilities and activities. The function of this Guide Book is to assist in the assessment and refinement of teacher preparation for industrial technology education in Texas.

Significance of the Guide Book

Unlike disciplines such as mathematics or the hard sciences, industrial technology education utilizes a knowledge base which is in a continual state of flux. New industrial processes, procedures and materials evolve constantly and, as these are vital components of industrial technology education, so must the total curriculum evolve to keep in step. As the curricular content adapts to reflect contemporary technology, so too must the methods used to prepare educators who are charged with relaying the content. It is hoped that this guidebook will convey, to those responsible for industrial technology teacher education in Texas, the most current thinking in the profession. The information contained within has been compiled from teacher educators, supervisors and classroom teachers from across the United States.

Development of the Guide Book

This Guide Book consists of four major sections. The first section provides preliminary information on the significance, development and use of the guide book. The second section contains the first industrial technology teacher preparation assessment instrument based on a national survey of model or exemplary industrial technology teacher preparation programs.

A survey questionnaire was carefully developed, from computer searches and advisory committee input (See Appendix A), to extract from identified model programs

various information regarding program makeup. State department of education level administrators from the 50 states were requested to identify model programs in their states. These programs were subsequently surveyed and the information gleaned from each was compiled (See Appendix B for results of the national survey). The final data from the national survey was used to generate the first of two teacher preparation assessment instruments. Assessment Instrument #1 is explained in Section II and will enable you to compare your existing program with current identified model programs in industrial technology teacher preparation throughout the United States, and with the fifteen industrial technology teacher preparation programs in Texas.

The third section of this Guide Book contains the second industrial teacher preparation assessment instrument. Assessment Instrument #2 was developed from the results of a three-round delphi study. A delphi panel consisting of thirteen individuals (See Appendix C) compiled thirty-nine statements descriptive of a model field experience in industrial technology teacher preparation (See Appendix D). These statements characterize the model field experience in terms of the University Curriculum, the University Supervisor, the Classroom Supervising Teacher, the Student Teacher and the Public School Environment. Assessment Instrument #2 will enable you to compare your program with an "ideal" program specified by the panel.

The fourth and final section of the Guide Book consists of suggested recommendations for program improvement. These recommendations have been written with consideration of: essential elements, special needs students, equal access and appropriate computer applications. Concurrence with the above was assured in the Guide Book revision process which included review by a Material Validation and Review Committee (See Appendix E) as well as review by the Project Advisory Committee (See Appendix F).

Use of the Guide Book

Utilization of this Guide Book is relatively straight forward. The university supervisor of industrial technology field experiences simply responds to the two assessment instruments (Sections II and III). Provided at the end of each are instructions for interpretation. Program shortcomings identified through the two assessment instruments may be rectified by effecting appropriate recommendations for program improvement

located in Section IV of the Guide Book. The appended findings of the national study (See Appendix B) and results of the delphi study (See Appendix D) can provide useful, factual data for purposes of comparison.

SECTION II
ASSESSMENT INSTRUMENT #1

This instrument consists of nineteen statements which relate to current industrial technology teacher preparation field experiences. The results, for comparative purposes, were obtained from: 1) the colleges/universities in Texas which prepare industrial technology teachers for state certification, and 2) a national study of industrial technology teacher education programs identified by their respective state director of industrial arts - or equivalent position - as model programs within the state. The statements are categorized into three areas: 1) Academic Requirements, 2) Student Teaching Assignment, and 3) Supervising Teacher. It is suggested that the university supervisor of industrial technology field experiences complete this instrument to determine how the local program compares to the current average model program throughout the United States and current average Texas program. Use Assessment Instrument #2 to assess the status of a local program with reference to the "ideal" program as specified by a national delphi panel of experts. Upon completion of the instruments, review the specific suggested recommendations for program improvement located in Section IV of this Guide Book.

Instructions - Assessment Instrument #1

Read each statement carefully. Check the answer below each statement that corresponds most accurately with your industrial technology teacher preparation program. After you have completed all statements, turn to page 10 and compare your answers with those of the national study as well as with the results from Texas colleges/universities.

Category I: Academic Requirements

Number	Statement
1.	How many hours of education classes (not counting student teaching) are required in the professional sequence for industrial technology teacher certification majors? ___ 0-9 ___10-15 ___16-21 ___22+
2.	Is industrial internship or cooperative education required for industrial technology teacher certification majors? ___Yes ___No
3.	Is a competency examination or exit examination in industrial technology required for industrial technology teacher certification majors? ___Yes ___No
4.	What is the minimum grade point average (GPA) required within the industrial technology specialization? _____(GPA)

Number	Statement
5.	What is the minimum general college/ university grade point average (GPA) required for certification/graduation? _____(GPA)

Category II: Student Teaching Assignment

Number	Statement
6.	Do students have input regarding placement into any particular school for student teaching? ___Yes ___No
7.	Are students given a choice of a rural, urban, or suburban setting for student teaching? ___Yes ___No
8.	Is each student teacher exposed to more than one type of teaching environment (rural, urban, suburban) in the student teaching assignment? ___Yes ___No
9.	Does each student teacher rotate through various industrial technologies (communication, energy, manufacturing/ construction) in the student teaching assignment? ___Yes ___No

Number	Statement
10.	What is the total number of weeks spent in the student teaching assignment? ___ 2-4 Weeks ___ 5-7 Weeks ___ 8-10 Weeks ___11-13 Weeks ___14-18 Weeks ___18+ Weeks
11.	How many hours a day are spent in the student teaching assignment? ___ 1-3 Hours ___ 4-6 Hours ___ 7-8 Hours
12.	How many days a week are spent in the student teaching assignment? ___ 1 Day ___ 2 Days ___ 3 Days ___ 4 Days ___ 5 Days ___ Varies
13.	Does the student teaching program require exposure to student leadership activities such as the American Industrial Arts Student Association? ___Yes ___No
14.	Does the program specify the number of hours that the student teacher must spend teaching in the student teaching assignment? ___Yes ___No

Number	Statement
15.	When does the student teaching assignment occur? ___ 3rd Year ___ 4th Year ___ 5th Year ___ All 4 Years ___ Other
16.	Who selects or assigns the supervising teacher. ___Public School Administration ___University Administration ___Other
17.	In what form is the public school supervising teacher compensated? ___Release Time ___College Credit Hours ___Career Ladder Steps ___Financial Renumeration to Supervising Teacher ___Financial Renumeration to School System ___Other
18.	Who specifies the duties of the public school supervising teacher? ___Local School System ___College/University ___Joint Responsibility of Local School System and College/University
19.	How often is the college/university supervising teacher required to visit the student teacher in the student teaching assignment? ___ Never ___ 1-3 Times ___ 4-6 Times ___ 7+ Times

Interpretation - Assessment Instrument #1

Assessment Instrument #1 is reprinted, but with the results of the national/Texas studies included. Next to each answer are the results of the national study followed by the results of the Texas study, in parenthesis. The results are given either in percentage of the total respondents selecting that answer or in simple descriptive statistics. Sometimes a respondent selected more then one answer, therefore, the percentages do not necessarily always total 100 percent. By careful, item-by-item analysis it is possible to determine which items might need to be addressed in order to have a program that is: 1) comparible to the average industrial technology field experience in Texas and/or 2) comparible to the average model industrial technology field experience throughout the United States. Remember, this comparison is to determine how your existing program compares to other existing programs. Turn to Section III to compare your existing program to an "ideal" program.

Category I: Academic Requirements

Number	Statement
1.	How many hours of education classes (not counting student teaching) are required in the professional sequence for industrial technology teacher certification majors? ___ 0-9 (14.06%)(00.00%) ___10-15 (39.06%)(58.33%) ___16-21 (23.44%)(16.67%) ___22+ (23.44%)(25.00%)
2.	Is industrial internship or cooperative education required for industrial technology teacher certification majors? ___Yes (7.81%)(00.00%) ___No (92.19%)(100.00%)

Number	Statement
3.	Is a competency examination or exit examination in industrial technology required for industrial technology teacher certification majors? ___Yes (28.13%)(8.33%) ___No (71.87%)(91.67%)
4.	What is the minimum grade point average (GPA) required within the industrial technology specialization? _____(GPA) (X = 2.36)(X = 2.375) (Med = 2.50)(Med = 2.50)
5.	What is the minimum general college/ university grade point average (GPA) required for certification/graduation? _____(GPA) (X = 2.15)(X = 2.15) (Med = 2.00)(Med = 2.00

Category II: Student Teaching Assignment

Number	Statement
6.	Do students have input regarding placement into any particular school for student teaching? ___Yes (95.31%)(100.00%) ___No (4.69%)(00.00%)
7.	Are students given a choice of a rural, urban, or suburban setting for student teaching? ___Yes (79.69%)(91.67%) ___No (20.31%)(8.33%)

Number	Statement
8.	Is each student teacher exposed to more than one type of teaching environment (rural, urban, suburban) in the student teaching assignment? ___Yes (23.44%)(8.33%) ___No (76.56%)(91.67%)
9.	Does each student teacher rotate through various technologies (communication, energy, manufacturing/construction) in the student teaching assignment? ___Yes (39.06%)(33.33%) ___No (60.94%)(66.67%)
10.	What is the total number of weeks spent in the student teaching assignment? ___ 2-4 Weeks (00.00%)(00.00%) ___ 5-7 Weeks (1.56%)(8.33%) ___ 8-10 Weeks (43.75%)(50.00%) ___11-13 Weeks (14.06%)(8.33%) ___14-18 Weeks (34.38%)(33.33%) ___18+ Weeks (6.25%)(00.00%)
11.	How many hours a day are spent in the student teaching assignment? ___ 1-3 Hours (1.56%)(00.00%) ___ 4-6 Hours (26.56%)(16.67%) ___ 7-8 Hours (71.88%)(83.33%)
12.	How many days a week are spent in the student teaching assignment? ___ 1 Day (00.00%)(00.00%) ___ 2 Days (1.56%)(00.00%) ___ 3 Days (00.00%)(00.00%) ___ 4 Days (00.00%)(00.00%) ___ 5 Days (98.44%)(100.00%) ___ Varies (00.00%)(00.00%)

Number	Statement
13.	Does the student teaching program require exposure to student leadership activities such as the American Industrial Arts Student Association? ___Yes (48.44%)(33.33%) ___No (51.56%)(66.67%)
14.	Does the program specify the number of hours that the student teacher must spend teaching in the student teaching assignment? ___Yes (67.19%)(75.00%) ___No (32.81%)(25.00%)
15.	When does the student teaching assignment occur? ___ 3rd Year (1.56%)(00.00%) ___ 4th Year (82.81%)(91.67%) ___ 5th Year (00.00%)(00.00%) ___ All 4 Years (6.25%)(00.00%) ___ Other (7.81%)(8.33%)
16.	Who selects or assigns the supervising teacher. ___Public School Administration (12.50%)(16.67%) ___University Administration (39.06%)(33.33%) ___Other (46.88%)(41.67%)
17.	In what form is the public school supervising teacher compensated? ___Release Time (4.69%)(8.33%) ___College Credit Hours (9.38%)(8.33%) ___Career Ladder Steps (00.00%)(00.00%) ___Financial Renumeration to Supervising Teacher (51.56%)(41.67%) ___Financial Renumeration to School System (7.81%)(41.67%) ___Other (25.00%)(16.67%)

Number	Statement
18.	Who specifies the duties of the public school supervising teacher? ___Local School System (9.37%)(16.67%) ___College/University (23.44%)(75.00%) ___Joint Responsibility of Local School System and College/University (67.19%)(8.33%)
19.	How often is the college/university supervising teacher required to visit the student teacher in the student teaching assignment? ___ Never (00.00%)(00.00%) ___ 1-3 Times (39.06%)(25.00%) ___ 4-6 Times (43.75%)(58.33%) ___ 7+ Times (17.19%)(16.67%)

SECTION III
ASSESSMENT INSTRUMENT #2

This instrument consists of thirty-nine statements which characterize a model or exemplary field experience (student teaching) program for industrial technology teacher education. The statements were generated by a thirteen member delphi panel representing teacher educators and classroom teachers. The statements are categorized into five areas: the University Curriculum, the University Supervisor, the Classroom Supervising Teacher, the Student Teacher and The Public School Environment. It is suggested that the university supervisor of industrial technology field experiences complete the instrument to assess the status of his/her program with reference to the "ideal" program specified by the delphi panel. Upon completion of the instrument, category totals can be used to identify specific suggested recommendations for program improvement located in Section IV of this Guide Book.

Instructions - Assessment Instrument #2

Read each statement carefully. On the scale below each, circle the number corresponding to the degree to which your program is characterized by the statement. After you have completed all statements, add the numeric values for the individual categories in the space provided. Also, transfer these values to the last page (24) of this instrument where it will be used to interpret the results of the assessment.

Category I: The University Curriculum

Number	Statement
1.	University course work provides instruction in the handling of discipline in the classroom.

Always — Sometimes — Seldom

10 9 8 7 6 5 4 3 2 1

2. University course work emphasizes competence in planning, organizing and conducting instruction in industrial technology education.

Always — Sometimes — Seldom

10 9 8 7 6 5 4 3 2 1

3. The curriculum addresses the financial responsibilities (i.e., bookkeeping, fundraising, etc.) associated with managing industrial technology education.

Always — Sometimes — Seldom

10 9 8 7 6 5 4 3 2 1

4. University course work provides awareness of the direction of curriculum change in the field of industrial technology education.

Always — Sometimes — Seldom

10 9 8 7 6 5 4 3 2 1

Number	Statement

5. The university provides current training in classroom supervising functions prior to the student teacher's field experience.

Always				Sometimes					Seldom
10	9	8	7	6	5	4	3	2	1

6. The university curriculum is designed to prepare students for experiences in both the middle and high school.

Always				Sometimes					Seldom
10	9	8	7	6	5	4	3	2	1

7. The curriculum includes how to start and run a student organization and its benefits to the overall industrial technology education program.

Always				Sometimes					Seldom
10	9	8	7	6	5	4	3	2	1

Please total your responses for Category I here ☐

Category II: The University Supervisor

Number	Statement

8. University supervision of the field experience is conducted by subject matter specialists who have at least three years of successful teaching experience.

Always				Sometimes					Seldom
10	9	8	7	6	5	4	3	2	1

9. The university supervisor is a qualified industrial technology teacher educator.

Always				Sometimes					Seldom
10	9	8	7	6	5	4	3	2	1

Number	Statement

10. The university supervisor visits the student teacher at least three times during the field experience.

Always Sometimes Seldom
10 9 8 7 6 5 4 3 2 1

11. The university supervisor is able to visit the field experience location without prior notification.

Always Sometimes Seldom
10 9 8 7 6 5 4 3 2 1

12. The university supervisor visits the student teacher on a regular basis.

Always Sometimes Seldom
10 9 8 7 6 5 4 3 2 1

Please total your responses for Category II here ☐

Category III: The Classroom Supervising Teacher

Number	Statement

13. The classroom supervising teacher is interviewed by university faculty before assignments are made.

Always Sometimes Seldom
10 9 8 7 6 5 4 3 2 1

14. The classroom supervising teacher has an up-to-date approach to industrial technology education so that the field experience is related to the future, not the past.

Always Sometimes Seldom
10 9 8 7 6 5 4 3 2 1

Number	Statement

15. The university specifies the duties of the classroom supervising teacher.

Always					Sometimes				Seldom
10	9	8	7	6	5	4	3	2	1

Please total your responses for Category III here ☐

Category IV: The Student Teacher

Number	Statement

16. The student teacher is given proper orientation to each field experience.

Always					Sometimes				Seldom
10	9	8	7	6	5	4	3	2	1

17. The student teacher is aware of the location of resources held for industrial technology education in the school library as well as the reference books kept in the laboratory.

Always					Sometimes				Seldom
10	9	8	7	6	5	4	3	2	1

18. The industrial technology education department at the university determines where student teachers are placed in the field.

Always					Sometimes				Seldom
10	9	8	7	6	5	4	3	2	1

19. The student teacher is informed of all insurances, coverages and protection that have been arranged for him or her.

Always					Sometimes				Seldom
10	9	8	7	6	5	4	3	2	1

Number	Statement

20. The student teacher participates in organizational, developmental, supervisory and maintenance activities appropriate to the classroom/laboratory setting.

Always Sometimes Seldom
10 9 8 7 6 5 4 3 2 1

21. The student teacher has direct contact with administrators, guidance counselors and support staff.

Always Sometimes Seldom
10 9 8 7 6 5 4 3 2 1

22. The student teacher is required to utilize a variety of teaching strategies, i.e., lecture, demonstration and mediated small and large group activities.

Always Sometimes Seldom
10 9 8 7 6 5 4 3 2 1

23. The student teacher participates in task analysis, task sequencing, task detailing and development of a lesson plan.

Always Sometimes Seldom
10 9 8 7 6 5 4 3 2 1

24. The student teacher is required to assist the classroom supervising teacher with posters, bulletin boards, models and other instructional aids used in teaching.

Always Sometimes Seldom
10 9 8 7 6 5 4 3 2 1

Number	Statement

25. The student teacher has an opportunity to request the technical area taught at the field experience school.

Always Sometimes Seldom
10 9 8 7 6 5 4 3 2 1

26. The student teacher attends extra curricular school activities with the classroom supervising teacher to whom he or she is assigned.

Always Sometimes Seldom
10 9 8 7 6 5 4 3 2 1

27. The student teacher is required to identify, acquire or develop appropriate instructional media/materials and equipment for various teaching situations prior to completion of the field experience.

Always Sometimes Seldom
10 9 8 7 6 5 4 3 2 1

28. Student teachers are required to become acquainted with the total program at the school where they teach.

Always Sometimes Seldom
10 9 8 7 6 5 4 3 2 1

Please total your responses for Category IV here ☐

Category V: The Public School Environment

Number	Statement

29. The field experience provides opportunities to observe the entire school day in a realistic manner.

Always Sometimes Seldom
10 9 8 7 6 5 4 3 2 1

30. The field experience includes several opportunities to assist in actual grading processes and grading systems.

Always Sometimes Seldom
10 9 8 7 6 5 4 3 2 1

31. The university has a well-established, written evaluation process with which to assess the quality of the student teacher's field experience.

Always Sometimes Seldom
10 9 8 7 6 5 4 3 2 1

32. There exists an up-to-date field experience handbook which provides orientation and criteria for evaluation of the field experience.

Always Sometimes Seldom
10 9 8 7 6 5 4 3 2 1

33. The field experience is structured to allow the student teacher to identify and utilize concepts presented in psychology courses and/or methods courses.

Always Sometimes Seldom
10 9 8 7 6 5 4 3 2 1

Number	Statement

34. The field experience provides activities that allow the student teacher to identify individual differences in students and develop teaching strategies appropriate to these differences.

Always — Sometimes — Seldom
10 9 8 7 6 5 4 3 2 1

35. There is an opportunity for a post-field experience seminar for all student teachers to collectively meet and discuss their learning.

Always — Sometimes — Seldom
10 9 8 7 6 5 4 3 2 1

36. The field experience is concentrated in the last semester of the student's degree program.

Always — Sometimes — Seldom
10 9 8 7 6 5 4 3 2 1

37. Classroom supervising teachers, student teachers and university supervisors engage in regularly scheduled seminars which address: (A) review of the progress of student teachers, (B) information critical to the success of student teachers, and (C) professional developments and concerns.

Always — Sometimes — Seldom
10 9 8 7 6 5 4 3 2 1

38. The field experience is offered after completion of all major field related courses.

Always — Sometimes — Seldom
10 9 8 7 6 5 4 3 2 1

Number	Statement
39.	The field experience does not put a financial strain on the student teacher.

Always 10 9 8 7 6 5 4 3 2 1 Seldom

Please total your responses for Category V here ☐

Interpretation - Assessment Instrument #2

Transfer your program category totals from pages 17, 18, 19, 21 and 24 into the spaces provided below. The 70th percent blocks adjacent to your program category totals indicate the minimum score a category should achieve if that aspect of your program is considered to be functioning satisfactorily. Should one or more of your program category totals fall below this level, you may wish to consult Section IV of this Guide Book for suggested recommendations for program improvement. Further, if any individual statement in any category is rated below 7 you may likewise wish to consult Section IV.

	Your Program Category Total	70th Percent
Category I: The University Curriculum (p 17)	☐	49
Category II: The University Supervisor (p 18)	☐	35
Category III: The Classroom Supervising Teacher (p 19)	☐	21
Category IV: The Student Teacher (p 21)	☐	91
Category V: The Public School Environment (p 24)	☐	77

SECTION IV
SUGGESTED METHODS FOR UPGRADING TEXAS PROGRAMS

Industrial technology draws its content from that part of the technological discipline which relates specifically to the broad definition of industry. The influence of technological innovation demands that a truly educated population possess an understanding of technology. Maintenance of local/state/national economic stability demands it. The advancement of standards of living demands it. Meaningful participation by an electorate in a technologically advanced democracy demands it. Provision for equal participation by all races and nationalities, by both sexes, and by the handicapped demands it.

The current Texas program includes three universals of industrial technology: visual communication, energy, and production. A primary goal of industrial technology education in public schools is to prepare youth to function effectively in a world of advancing technology. The objectives of industrial technology education are based on the assumption that a technologically literate person will be competent to:

- solve technological problems.
- make wise selections of products and services of industry.
- assess interest in and awareness of career opportunities and requirements.
- use problem solving techniques to plan and design products using visual communication, energy, and production techniques.
- explore the past, present, and future of industrial technology and its influence on society.
- use safely the tools, machines, materials, and processes of industry.
- select and prepare for productive employment in the world of work.
- participate effectively as a member of an industrial/democratic society.
- communicate effectively: man and man, man and machine, machine and man, and machine and machine.

Based on the nature of the American culture, the technological system, the needs of students, and the goals of public education in Texas, industrial technology seeks to achieve the following objectives in secondary schools. Industrial technology provides opportunities for students to:

- investigate the relationship of visual communication, energy, and production technology in the technological system.
- explore entrepreneurship and its place within the free enterprise system.
- exhibit responsibility and leadership skills by using democratic principles.
- develop competencies in the safe use of tools, machines, materials, and processes of technology.
- solve technological problems through the application of competencies in the humanities and sciences.
- investigate the nature of the technological world - past, present, and future and its influence on our society.
- develop interest and awareness in career opportunities and leisure time activities in a technetronic society.
- make wise selections of consumer products and services of technological society.

The goals of industrial technology are achieved through diverse course offerings in grades 7 through 12 in each of the three technology clusters. The courses are organized around three levels which are: Introductory, General, and Advanced.

Introductory Industrial Technology I and II are designed for grades seven and eight. Introductory Industrial Technology I is a first year program and covers essential elements in Visual Communication Technology, Energy Technology, and Production Technology (See Appendix G). Introductory Industrial Technology II is a second year program and covers essential elements in manufacturing and construction (See Appendix H).

The curriculum in the high school is designed to fulfill two specific needs. General Industrial Technology fulfills the needs of students who did not have an opportunity to enroll in Introductory Industrial Technology in grades seven and eight. The essential elements for General Industrial Technology are the same as Introductory Industrial Technology I (See Appendix I). The Industrial Technology program in grades nine through twelve is designed for those who wish to study the specific technologies in greater depth. Each of the Industrial Technology courses cover specific topics of study at the general and advanced levels in each of the three technologies: communication, energy, and production. Each of the courses offered should cover all of the essential elements listed under each of the courses (See Appendix J).

Recommendations Based on the National/State Surveys

Utilizing Assessment Instrument #1 in Section II of this publication it is possible to compare an existing industrial technology teacher education field experience program to: 1) the average industrial technology field experience in Texas, and 2) the average model industrial technology field experience throughout the United States. By comparing the discreet data, it is possible to note the differences and to pursue the possibility of changing an existing program to be comparable with other existing programs. However, it must be stressed that any changes should reflect the essential elements of the new curriculum.

Recommendations Based on the Delphi Study

The delphi study resulted in a series of statements which characterized a model field experience in industrial technology teacher education. These statements have been analyzed in order to compile the suscinct listing of suggested recommendations for program improvement which follow. The listing is divided into the five categories used in the delphi study and the assessment instrument in Section III of this Guide Book. The listings are not intended to be all inclusive.

Recommendations for the University Curriculum

It is recommended that the university curriculum should:

1. Demonstrate a variety of disciplinary strategies.
2. Address varying levels of disciplinary problems from the least to the most severe.
3. Incorporate interviews with middle and high school vice principals and counselors.
4. Use case studies to analyze discipline problems and corrective actions.
5. Utilize the essential elements in lesson planning.
6. Require detailed lesson plans which incorporate appropriate media.
7. Emphasize the continuity between objectives and lesson plans.
8. Require exposure to various instructional methods.
9. Expose students to basic bookkeeping methods applicable to industrial technology laboratories.
10. Expose students to various fundraising strategies.

11. Demonstrate the direction of curriculum change and evolution.
12. Expose students to various curriculum concepts/trends.
13. Demonstrate the similarities and differences among various curriculum concepts/trends.
14. Provide formal classroom instruction in classroom supervisory concepts.
15. Expose students to a variety of supervisory techniques.
16. Emphasize planning and organizing instruction for middle school and high school.
17. Emphasize instructional methods suitable for middle school and high school.
18. Emphasize relevant computer applications for middle school and high school.
19. Expose student teachers to a variety of student organizations.
20. Emphasize the benefits accrued from student organizations.
21. Provide detailed instructions regarding the start up and running of student organizations.
22. Provide formal classroom instruction dealing with mainstreaming special needs students in laboratory activities.

Recommendations for the University Supervisor

It is recommended that the university supervisor should:

23. Be a true subject matter specialist.
24. Have a minimum of three years of full time classroom teaching experience.
25. Have teaching experience in a range of technical disciplines.
26. Have formal classroom instruction in a range of technical disciplines including computer applications.
27. Be a licensed, practicing industrial technology educator.
28. Make field visitations at least three times during the field experience.
29. Make field visitations on a regular but unannounced basis.
30. Make a verbal assessment of the student teachers performance at the completion of each visit.
31. Be available to the student teacher for consultation regarding problems at the field experience site.
32. Confer with the classroom supervising teacher when at the field experience site.

Recommendations for the Classroom Supervising Teacher

It is recommended that the classroom supervising teacher should:

33. Be thoroughly interviewed regarding his/her competence as a classroom supervising teacher prior to the actual placement of student teachers.
34. Be periodically interviewed by university personnel regarding his/her competence as a classroom supervising teacher.
35. Display in his/her teaching, an approach which demonstrates a working knowledge of current curricular trends in industrial technology education.
36. Utilize instruction which takes into account appropriate essential elements.
37. Utilize instruction which takes into account appropriate computer applications.
38. Involve the student teacher in instructional activities which emphasize the future, not the past.
39. Adhere to specific duties, pertaining to the field experience, which have been specified by the university.
40. Cooperate fully with the university supervisor in matters pertaining to the field experience.
41. Demonstrate and utilize instructional strategies appropriate to the learning needs of special students.

Recommendations for the Student Teacher

It is recommended that the student teacher should:

42. Orient himself/herself to the field experience site and personnel prior to actual student teaching.
43. Discuss individual field experience expectations with the university supervisor and classroom supervising teacher prior to actual student teaching.
44. Visit with the administrative and counseling staffs at the field experience site prior to actual student teaching.
45. Become familiar with reference books at the field experience library.
46. Become familiar with the media available at the field experience library.
47. Become familiar with reference books and media available in the industrial technology laboratory to which he/she is assigned.

48. Become familiar with the computer hardware and software available at the field experience site.
49. Be assigned a field experience site by the university supervisor based on factors such as type of school, student demographics, facilities available at the field experience site, etc.
50. Provide input to the university supervisor regarding choice of site.
51. Understand fully the insurances, coverages and protection afforded him/her at the field experience site.
52. Take an active role in the lab maintenance activities.
53. Participate in the supervisory activities associated with running an industrial technology lab.
54. Contribute, to the extent possible, in the curriculum development efforts at the field experience site.
55. Assist the classroom supervising teacher in the development of appropriate media and instructional aids.
56. Make meaningful contact with field experience school administrators, counselors and support staff.
57. Gain an understanding of the function of the guidance counseling staff.
58. Gain an understanding of the function of the administrative staff.
59. Utilize the demonstration method to teach units pertaining to the essential elements.
60. Use the lecture method in an appropriate manner.
61. Adapt instructional techniques to at least two special needs popultions.
62. Utilize large and small group activities to relay content in a variety of technologies.
63. Use the group discussion method to investigate safety concepts and concerns.
64. Use the group discussion method to explore possible future trends in the labor market.
65. Utilize the product method to explain such concepts as line production and interchangeability of parts.
66. Demonstrate fundamentals of engineering documentation.
67. Select the best instructional methodology for a given learning unit.
68. Experiment with various learning methods.
69. Incorporate concepts learned in psychology and methods courses.
70. Conduct a series of task analyses, beginning with the simple and progressing toward the more difficult.
71. Complete task sequencing and task detailing for several appropriate tasks.
72. Develop lesson plans for each lesson taught.

73. Revise lesson plans to incorporate input from the teaching of the lesson.
74. Analyze and study the lesson plans used by the classroom supervising teacher.
75. Utilize input from the guidance/counseling staff in the development of IEPs for special needs students.
76. Develop or acquire safety posters for the lab.
77. Assist the classroom supervising teacher in constructing models which address specific essential elements in various technical areas.
78. Maintain a bulletin board in the lab which displays the finer work of students.
79. Suggest, to the university supervisor, technical areas for which he/she would be a competent student teacher.
80. Attend various extracurricular activities with the assigned classroom supervising teacher.
81. Take an active role in extracurricular activities.
82. discuss, with the classroom supervising teacher and/or other teachers, extracurricular activities for which participation is not possible.
83. Collect technical literature from manufacturers.
84. Compile a comprehensive listing of commercial media for use in at least two technologies.
85. Create a file of vendor catalogs (publishers, suppliers, etc.)
86. Spend at least one hour per week walking around the field experience school to get a feel for the total program.

Recommendations for the Public School Environment

It is recommended that the public school environment should:

87. Provide ample opportunity for the student teacher to observe all aspects of the instructional program.
88. Provide opportunity for the student teacher to interact with various professionals at the site.
89. Enable the student teacher to participate in grading of assignments and evaluative instruments.
90. Expose the student teacher to the widest possible variety of grading systems and procedures.
91. Expose the student teacher to at least one grading period and one semester grading interval.
92. Provide expert guidance in interpretation and assignment of grades.
93. Include an established written document with which to assess the quality of field experiences.

94. Provide to the student teacher, prior to the commencement of the field experience, criteria by which the field experience will be assessed.
95. Provide guidance in the interpretation of the assessment criteria for field experiences.
96. Include an up-to-date field experience handbook.
97. Include an orientation to the school for the incoming student teacher.
98. Provide channels of communication through which the student teacher can seek advice as he/she adjusts to the field experience site.
99. Provide concrete opportunities to identify and utilize psychological concepts relevant to the learning environment.
100. Provide opportunities to apply various theories of learning.
101. Provide time for one-on-one teaching.
102. Allow the student teacher to work with individual students with special learning problems.
103. Provide opportunities for the student teacher to observe individual differences, and structure learning to accommodate such differences.
104. Include a post-field experience seminar in which all student teachers collectively discuss their experiences.
105. Include regularly scheduled seminars for student teachers, classroom supervising teachers and the university supervisor.
106. Mainstream special needs students in industrial arts classes.
107. Provide a learning/teaching environment that will not pose a financial strain on the student teacher.

APPENDIX A

Assessment Instrument
of
Model Industrial Technology
Field Experience Programs

Program Identification Number: ☐

INSTRUMENT #1: ASSESSMENT OF MODEL FIELD EXPERIENCE PROGRAMS

INSTRUCTIONS: Please read each of the following items carefully. Respond by placing a check mark (✓) in the appropriate box; some responses may require you to write in a brief phrase. Try to respond to all items. Your time and effort with this instrument is greatly appreciated.

I Demographics: Professional

1. What is your professional capacity?
   ☐ administrator ☐ faculty ☐ other _____ (specify)

2. Do you deal with student teachers in your professional capacity?
   ☐ yes ☐ no

3. Characterize your responsibilities with the student teacher program (check all that apply):
   ☐ administration ☐ other _____ (specify)
   ☐ direct supervision

4. Indicate the highest degree you have earned:
   ☐ bachelor ☐ master ☐ doctor

II Demographics: Institutional

5. Indicate the type of institution:
   ☐ college ☐ university

6. What is the enrollment of your institution?
   ☐ less than 5000 ☐ 25000 to 35000
   ☐ 5000 to 15000 ☐ 35000+
   ☐ 15000 to 25000

7. Characterize the institution's environment:
   ☐ urban ☐ rural ☐ suburban

8. How many students, seeking teacher certification, are enrolled as majors in the industrial arts or industrial technology program?
   ☐ less than 25 ☐ 51 to 100
   ☐ 25 to 50 ☐ 100+

III Academic Requirements

9. Indicate if credit hours are semester or quarter:
   ☐ semester ☐ quarter

10. Specify the total number of credit hours required for the undergraduate teaching major in industrial arts: ☐

11. How many hours of education classes (not counting student teaching) are required in the professional sequence for teaching majors?
   ☐ 0 to 9 ☐ 16 to 21
   ☐ 10 to 15 ☐ 22+

IV Student Teaching Assignment

12. Do students have input into their placement in student teaching?
☐yes ☐no

13. Are students given a choice of a rural, urban, or suburban setting?
☐yes ☐no

14. Are student teachers exposed to more than one type of teaching environment (i.e., rural, urban, suburban) in the assignment?
☐yes ☐no

15. What is the total number of weeks spent in the assignment?
☐2 to 4 weeks ☐11 to 13 weeks
☐5 to 7 weeks ☐14 to 18 weeks
☐8 to 10 weeks ☐18+ weeks

16. How many hours a day are spent in the student teaching assignment?
☐1 to 3 hours ☐7 to 8 hours
☐4 to 6 hours

17. How many days a week are spent in the student teaching assignment?
☐1 day ☐4 days
☐2 days ☐5 days
☐3 days ☐varies

18. Does your program specify the number of hours that the student teacher must spend teaching in the assignment?
☐yes ☐no

19. Is the student teaching assignment distributed throughout the years of the academic program?
☐yes ☐no

20. If the student teaching assignment is not distributed, when does it occur?
☐end of the 3rd year ☐other_____
☐end of the 4th year (specify)

21. Is student teaching designated as a 5th year?
☐yes ☐no

V Supervising Teacher (master teacher or public school supervisor)

22. In what form is the public school supervising teacher compensated?
☐financial renumeration ☐release time
☐career ladder steps ☐other _____
☐college credit hours (specify)

23. Does the university specify the duties of the public school supervising teacher?
☐yes ☐no

24. How often does the university supervising teacher visit the public school supervising teacher?
☐never ☐4 to 6 times
☐1 to 3 times ☐7+times

APPENDIX B

Survey Results
of
Model Industrial Technology
Field Experience Programs

TABLE 1
DEMOGRAPHICS
PROFESSIONAL/INSTITUTIONAL

Statement	Category	National		Texas(12)	
		Number	%	Number	%
1. Professional Capacity	Administrator	40	62.50	8	66.67
	Faculty	30	46.88	3	25.00
	Other	6	9.38	3	25.00
2. Responsibilities with the student teacher program	Administration	34	53.13	6	50.00
	Direct Supervision	24	37.50	3	25.00
	None	9	14.06	3	25.00
	Other	13	20.31	1	8.33
3. Highest earned degree	Bachelor	0	00.00	0	00.00
	Master	5	7.81	1	8.33
	Doctor	59	92.19	11	91.67
4. Type of institution	College	10	15.63	0	00.00
	University	54	84.37	12	100.00
5. Enrollment at Institution	less than 5,000	16	25.00	5	41.67
	5,000-15,000	5	7.81	3	25.00
	15,000-25,000	13	20.31	2	16.67
	25,000-35,000	26	40.63	1	8.33
	35,000+	4	6.25	1	8.33
6. Institutional Environment	Urban	19	29.69	4	33.33
	Suburban	18	28.12	4	33.33
	Rural	27	42.19	4	33.33
7. Number of students seeking teacher certification and enrolled as industrial arts/ industrial technology majors	less than 25	15	23.44	5	41.67
	25-50	23	35.94	4	33.33
	51-100	18	28.12	3	25.00
	100+	8	12.50	0	00.00

Responses(64)

TABLE 2
ACADEMIC REQUIREMENTS

Statement	Category	Responses(64) National Number	National %	Texas(12) Number	Texas(12) %
8. Type of credit hours utilized *	Semester hours	49	76.56	12	100.00
	Quarter hours	15	23.44	0	00.00
9. Semester hours of required education classes in the professional sequence (not including student teaching)	0-9	9	14.06	0	00.00
	10-15	25	39.06	7	58.33
	16-21	15	23.44	2	16.67
	22+	15	23.44	3	25.00
10. (A) Additional Requirements	Industrial Internship or Cooperative Education	5	7.81	0	00.00
	Competency/Exit Exam in Industrial Technology	18	28.13	1	8.33
		M	Median	M	Median
(B) Minimum required grade point average(GPA)	Industrial Arts/Industrial Technology	2.36	2.50	2.375	2.50
	College/University	2.15	2.00	2.15	2.00

* Because of poor word usage on the instrument, the actual number of credit hours could not be utilized.

TABLE 3
STUDENT TEACHING ASSIGNMENT

Statement	Category	National		Texas(12)	
		Responses(64)			
		Number	%	Number	%
11. Students have input into their placement into a particular school for student teaching.	Yes	61	95.31	12	100.00
	No	3	4.69	0	00.00
12. Students given a choice of rural, urban, or suburban location for student teaching.	Yes	51	79.69	11	91.67
	No	13	20.31	1	8.33
13. Student teacher exposed to more than one type of teaching environment(rural, urban, suburban) during student teaching assignment.	Yes	15	23.44	1	8.33
	No	49	76.56	11	91.67
14. Each student teacher rotates through various technologies (Communication, Energy/Power, Manufacturing/Construction) during student teaching assignment.	Yes	25	39.06	4	33.33
	No	39	60.94	8	66.67
15. Total number of weeks spent in student teaching assignment	2-4 weeks	0	00.00	0	00.00
	5-7 weeks	1	1.56	1	8.33
	8-10 weeks	28	43.75	6	50.00
	11-13 weeks	9	14.06	1	8.33
	14-18 weeks	22	34.38	4	33.33
	18+ weeks	4	6.25	0	00.00
16. Total time spent each day in student teaching assignment	1-3 hours	1	1.56	0	00.00
	4-6 hours	17	26.56	2	16.67
	7-8 hours	46	71.88	10	83.33

TABLE 3(CONT.)
STUDENT TEACHING ASSIGNMENT

Statement	Category	Responses(64) National Number	National %	Texas(12) Number	Texas(12) %
17. Days per week spent in student teaching assignment.	1 day	0	00.00	0	00.00
	2 days	1	1.56	0	00.00
	3 days	0	00.00	0	00.00
	4 days	0	00.00	0	00.00
	5 days	63	98.44	12	100.00
	Varies	0	00.00	0	00.00
18. Student Teaching program requires exposure to student leadership activities such as the American Industrial Arts Student Association (AIASA)	Yes	31	48.44	4	33.33
	No	33	51.56	8	66.67
19. The program specifies the number of hours that the student teacher must spend teaching in the student teaching assignment.	Yes	43	67.19	9	75.00
	No	21	32.81	3	25.00
20. Student teaching is distributed throughout the freshman through senior years	Yes	4	6.25	0	00.00
	No	60	93.75	12	100.00
21. Occurance of student teaching(other than in question 20)	3rd year	1	1.56	0	00.00
	4th year	53	82.81	11	91.67
	5th year	0	00.00	0	00.00
	Other	5	7.81	1	8.33
	No Response	1	1.56	0	00.00

TABLE 4
SUPERVISING TEACHER

Statement	Category	National Number	National %	Texas(12) Number	Texas(12) %
		Responses(64)			
22. Selects/Assigns the supervising teacher	Public School Administration	8	12.50	2	16.67
	University Administration	25	39.06	4	33.33
	Other	30	46.88	5	41.67
	No response	1	1.56	1	8.33
23. Compensation of public school supervising teacher	Release Time	3	4.69	1	8.33
	College Credit Hours	6	9.38	1	8.33
	Career Ladder Steps	0	00.00	0	00.00
	Financial Renumeration to Supervising Teacher	33	51.56	5	41.67
	Financial Renumeration to Local School System	5	7.81	5	41.67
	Other	16	25.00	2	16.67
	No response	1	1.56	1	8.33
24. Specifies duties of public school supervising teacher	Local School System	6	9.37	2	16.67
	College/University	15	23.44	9	75.00
	Joint Responsibility	43	67.19	1	8.33
25. Number of times the university supervising teacher required to visit the student teacher in the student teaching assignment	Never	0	00.00	0	00.00
	1-3 times	25	39.06	3	25.00
	4-6 times	28	43.75	7	58.33
	7 + times	11	17.19	2	16.67

APPENDIX C

Delphi Panel Membership

Teacher Education Representatives

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Nedom C. Muns
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Industrial Arts Classroom Teacher Representatives

American Industrial Arts Association

Les Litherland
Evert Junior High School
Lakewood, Colorado

TIAA Outstanding Teacher Awardees

Fred Blount
Lee High School
Midland, Texas

Lloyd Gober
O.Henry Junior High School
Austin, Texas

Jim Payne
Victoria High School
Victoria, Texas

Outstanding American Industrial Arts Student Association Chapter Avisors - Levels 1 and 2

Steve Price	Vaughn Croft
Point South Junior High School	Santa Rosa High School
Lakewood, Colorado	Tucson, Arizona

The representative from the current or most recent classroom teacher from the vice president post within the Industrial Arts Division of the American Vocational Association was ommitted at the discretion of the American Vocational Association.

APPENDIX D

Statements that Characterize a Model Industrial Technology Field Experience

Category I: The University Curriculum

Number	Statement
1.	University course work provides instruction in the handling of discipline in the classroom.
2.	University course work emphasizes competence in planning, organizing and conducting instruction in industrial technology education.
3.	The curriculum addresses the financial responsibilities (i.e., bookkeeping, fundraising, etc.) associated with managing industrial technology education.
4.	University course work provides awareness of the direction of curriculum change in the field of industrial technology education.
5.	The university provides current training in classroom supervising functions prior to the student teacher's field experience.
6.	The university curriculum is designed to prepare students for experiences in both the middle and high school.
7.	The curriculum includes how to start and run a student organization and its benefits to the overall industrial technology education program.

Category II: The University Supervisor

Number	Statement
8.	University supervision of the field experience is conducted by subject matter specialists who have at least three years of successful teaching experience.
9.	The university supervisor is a qualified industrial technology teacher educator.
10.	The university supervisor visits the student teacher at least three times during the field experience.

Number	Statement
11.	The university supervisor is able to visit the field experience location without prior notification.
12.	The university supervisor visits the student teacher on a regular basis.

Category III: The Classroom Supervising Teacher

Number	Statement
13.	The classroom supervising teacher is interviewed by university faculty before assignments are made.
14.	The classroom supervising teacher has an up-to-date approach to industrial technology education so that the field experience is related to the future, not the past.
15.	The university specifies the duties of the classroom supervising teacher.

Category IV: The Student Teacher

Number	Statement
16.	The student teacher is given proper orientation to each field experience.
17.	The student teacher is aware of the location of resources held for industrial technology education in the school library as well as the reference books kept in the laboratory.
18.	The industrial technology education department at the university determines where student teachers are placed in the field.
19.	The student teacher is informed of all insurances, coverages and protection that have been arranged for him or her.
20.	The student teacher participates in organizational, developmental, supervisory and maintenance activities appropriate to the classroom/laboratory setting.

Number	Statement
21.	The student teacher has direct contact with administrators, guidance counselors and support staff.
22.	The student teacher is required to utilize a variety of teaching strategies, i.e., lecture, demonstration and mediated small and large group activities.
23.	The student teacher participates in task analysis, task sequencing, task detailing and development of a lesson plan.
24.	The student teacher is required to assist the classroom supervising teacher with posters, bulletin boards, models and other instructional aids used in teaching.
25.	The student teacher has an opportunity to request the technical area taught at the field experience school.
26.	The student teacher attends extra curricular school activities with the classroom supervising teacher to whom he or she is assigned.
27.	The student teacher is required to identify, acquire or develop appropriate instructional media/materials and equipment for various teaching situations prior to completion of the field experience.
28.	Student teachers are required to become acquainted with the total program at the school where they teach.

Category V: The Public School Environment

Number	Statement
29.	The field experience provides opportunities to observe the entire school day in a realistic manner.
30.	The field experience includes several opportunities to assist in actual grading processes and grading systems.

Number	Statement
31.	The university has a well-established, written evaluation process with which to assess the quality of the student teacher's field experience.
32.	There exists an up-to-date field experience handbook which provides orientation and criteria for evaluation of the field experience.
33.	The field experience is structured to allow the student teacher to identify and utilize concepts presented in psychology courses and/or methods courses.
34.	The field experience provides activities that allow the student teacher to identify individual differences in students and develop teaching strategies appropriate to these differences.
35.	There is an opportunity for a post-field experience seminar for all student teachers to collectively meet and discuss their learning.
36.	The field experience is concentrated in the last semester of the student's degree program.
37.	Classroom supervising teachers, student teachers and university supervisors engage in regularly scheduled seminars which address: (A) review of the progress of student teachers, (B) information critical to the success of student teachers, and (C) professional developments and concerns.
38.	The field experience is offered after completion of all major field related courses.
39.	The field experience does not put a financial strain on the student teacher.

APPENDIX E

Material Validation and Review Committee Membership

19 TAC Chapter 75
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Equal Access
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APPENDIX F

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Applied Data Research, Inc.
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Lloyd Carter
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Fort Worth ISD
Fort Worth, Texas

APPENDIX G

Essential Elements for
Introductory Industrial Technology I

I. Introductory Industrial Technology, grades seven-eight, shall include the essential elements common to all programs. Students may take the Introductory Industrial Technology program for one or two years. Students taking the first year of the program or Introductory Industrial Technology I may study six-12 weeks of Visual Communication Technology, six-12 weeks of Energy Technology, and six-18 weeks of Production Technology. Students taking the second year of the program or Introductory Industrial Technology II may study 12-24 weeks of Construction Technology and 12-24 weeks of Manufacturing Technology.

A. Concepts and skills in the application of safety procedures. The student shall be provided opportunities to:
   1. demonstrate safe operation and use of selected tools and equipment to avoid injury; and
   2. maintain safe conditions in the laboratory

B. Concepts and skills related to planning, designing, and problem solving. The student shall be provided opportunities to:
   1. plan and design industrial products of the student's choice;
   2. measure accurately using metric or customary units;
   3. complete itemized list of materials; and
   4. make working drawings of projects.

C. Concepts and skills related to the tools, materials, and processes of technology. The student shall be provided opportunities to:
   1. solve industrial problems by utilizing a variety of industrial materials;
   2. use correctly selected hand and machine tools; and'
   3. select the most suitable process to complete a project.

D. Concepts and skills related to the past, present, and future of technology. The student shall be provided opportunities to:
   1. recognize ideas and inventions of the past and present; and
   2. relate technological change to the skills needed for the future.

E. Concepts and skills related to evaluating products and services of technology. The student shall be provided opportunities to:
   1. recognize good design and construction;
   2. evaluate products based on given standards or applications;
   3. service industrial products and equipment; and

4. develop criteria for selecting, purchasing, and contracting services.

F. Leadership concepts and skills. The student shall be provided opportunities to
   1. identify characteristics and responsibilities of leaders and effective group members;
   2. participate in orderly meetings conducted according to parliamentary procedure (optional on occupational orientation);
   3. function effectively on committees (optional in occupational orientation);
   4. plan and conduct leadership activities; and
   5. prepare for effective citizenship and participation in our democratic society.

G. Concepts and skills related to successful employment. The student shall be provided opportunities to:
   1. develop an awareness of employment opportunities in chosen field;
   2. practice correct procedures for job application and interview;
   3. develop the ability to take and follow both oral and written directions;
   4. practice punctuality and dependability;
   5. observe rules and standards of the work place;
   6. demonstrate an ability to work with others harmoniously;
   7. develop responsibility and the ability to follow through on assigned tasks; and
   8. exhibit productive work habits and attitudes.

H. Concepts and skills associated with entrepreneurship. The student shall be provided opportunities to:
   1. recognize opportunities and options for business ownership;
   2. identify entry-level procedures, planning processes, and terms needed to open a business; and
   3. develop an understanding of the role of small business in the free enterprise system.

II. Every school offering Introductory Industrial Technology I shall provide the essential elements common to introductory industrial technology and the following essential elements:

A. Concepts and skills related to visual communication technology. The student shall be provided opportunities to:

1. make freehand technical drawings;
2. apply accepted lettering practices and styles;
3. construct multiview projections with instruments;
4. describe object size by standard dimensioning practice;
5. describe objects through pictorial methods;
6. apply design principles to composition and layout techniques.
7. operate standard reproduction and duplicating equipment;
8. use standard finishing techniques;
9. produce products using accepted methods of image generation;
10. study the types and uses of visual communications equipment;
11. use computer software to design and make drawings;
12. explore the use of function codes in computer numerical control of production machines; and
13. use data base software to assist in collecting, storing, retrieving, and applying information for industrial applications.

B. Concepts and skills related to energy technology. The student shall be provided opportunities to:
1. use apparatus and devices that demonstrate the generation, conversion, and control of mechanical, electrical, and pneumatic-hydraulic power;
2. construct static or working models or examples of devices that generate, convert, or control energy;
3. utilize computers for the collection and analysis of data relevant to energy technology;
4. compare transportation systems that move people and materials by land, sea, air, and space;
5. plan and implement the controlled movement of robots;
6. use instrumentation with computers to monitor data-based systems;
7. compare transmission systems that move energy by electrical, electronic, mechanical, and pneumatic-hydraulic technologies;
8. construct static or working models that demonstrate devices or systems used to move people and materials;

9. construct static or working models that demonstrate devices or systems that transmit energy; and
10. read and interpret maps, charts, and schedules.

C. Concepts and skills related to production technology. The student shall be provided opportunities to:
1. apply industrial organization and management systems by planning, organizing, and controlling production processes;
2. apply primary industrial processes of layout, testing, separating and cutting, drilling and boring, shaping and forming, casting, laminating, coating, decorating, joining, and finishing;
3. research the recycling of industrial materials;
4. plan and implement the various steps in the construction process;
5. research the transformation of raw materials into finished products;
6. plan and implement mass production activities;
7. demonstrate techniques and processes used in automated production systems; and
8. use computers in planning, production, quality control, and management of production systems.

APPENDIX H

Essential Elements for Introductory Industrial Technology II

I. Introductory Industrial Technology II (grade eight - 1/2 - 1 unit). Every school offering Introductory Industrial Technology II shall provide the essential elements common to Introductory Industrial Technology.

A. Concepts and skills in the application of safety procedures. The student shall be provided opportunities to:
   1. demonstrate safe operation and use of selected tools and equipment to avoid injury; and
   2. maintain safe conditions in the laboratory

B. Concepts and skills related to planning, designing, and problem solving. The student shall be provided opportunities to:
   1. plan and design industrial products of the student's choice;
   2. measure accurately using metric or customary units;
   3. complete itemized list of materials; and
   4. make working drawings of projects.

C. Concepts and skills related to the tools, materials, and processes of technology. The student shall be provided opportunities to:
   1. solve industrial problems by utilizing a variety of industrial materials;
   2. use correctly selected hand and machine tools; and'
   3. select the most suitable process to complete a project.

D. Concepts and skills related to the past, present, and future of technology. The student shall be provided opportunities to:
   1. recognize ideas and inventions of the past and present; and
   2. relate technological change to the skills needed for the future.

E. Concepts and skills related to evaluating products and services of technology. The student shall be provided opportunities to:
   1. recognize good design and construction;
   2. evaluate products based on given standards or applications;
   3. service industrial products and equipment; and
   4. develop criteria for selecting, purchasing, and contracting services.

F. Leadership concepts and skills. The student shall be provided opportunities to:
   1. identify characteristics and responsibilities of leaders and effective group members;

2. participate in orderly meetings conducted according to parliamentary procedure (optional on occupational orientation);
3. function effectively on committees (optional in occupational orientation);
4. plan and conduct leadership activities; and
5. prepare for effective citizenship and participation in our democratic society.

G. Concepts and skills related to successful employment. The student shall be provided opportunities to:
1. develop an awareness of employment opportunities in chosen field;
2. practice correct procedures for job application and interview;
3. develop the ability to take and follow both oral and written directions;
4. practice punctuality and dependability;
5. observe rules and standards of the work place;
6. demonstrate an ability to work with others harmoniously;
7. develop responsibility and the ability to follow through on assigned tasks; and
8. exhibit productive work habits and attitudes.

H. Concepts and skills associated with entrepreneurship. The student shall be provided opportunities to:
1. recognize opportunities and options for business ownership;
2. identify entry-level procedures, planning processes, and terms needed to open a business; and
3. develop an understanding of the role of small business in the free enterprise system.

II. Every school offering Introductory Industrial Technology II shall provide essential elements related to the Manufacturing and Construction areas of Production Technology.

A. Concepts and skills related to production technology in the area of manufacturing. The student shall be provided opportunities to:
1. participate in activities involving product researching, designing, and marketing;
2. investigate financial resources needed in industrial production;
3. plan and implement mass production activities;

4. apply industrial organization and management systems by planning, organizing, and controlling production processes;
5. develop production charts and graphs;
6. demonstrate an awareness of automated systems used in manufacturing;
7. recognize basic material standards and terminology used in industry;
8. apply the basic industrial processes to manufacturing;
9. research the recycling of manufacturing materials; and
10. use computers in planning, production, quality control, and management of production systems.

B. Concepts and skills related to production technology in the areas of construction. The student shall be provided opportunities to:
1. analyze those processes involved in selecting and acquiring a construction site;
2. design and construct a foundation, floor, wall, ceiling, and roof;
3. research pre-fabricated systems;
4. participate in electrical system installation activities;
5. practice simple plumbing techniques;
6. practice trimming and finishing techniques;
7. explore remodeling procedures;
8. practice basic masonry techniques;
9. discuss contracting and subcontracting practices;
10. develop a basic knowledge of landscaping;
11. research new construction materials and methods;
12. explore energy conservation principles involved in construction;
13. explore techniques and processes used in automated production systems; and
14. research the recycling of construction materials.

APPENDIX I

Essential Elements for General Industrial Technology

I. General Industrial Technology (1/2 - 1 unit) is designed for students who have not had Introductory Industrial Technology in the middle school. The program structure and content for General Industrial Technology are the same as in Introductory Technology with the exception that it is only a one-year program. The high school common core is utilized rather than the middle school core. Teaching strategies for this course are modified to accommodate the high school student. Industrial Technology courses grades 9-12 shall include the essential elements common to all programs.

A. Concepts and skills in the application of safety procedures. The student shall be provided opportunities to:
   1. demonstrate safe operation of selected tools and equipment;
   2. maintain safe conditions in laboratories; and
   3. evaluate laboratories and facilities for unsafe conditions.

B. Concepts and skills in planning, designing, and problem solving. The student shall be provided opportunities to:
   1. plan and design industrial products of the student's choice;
   2. apply problem-solving techniques to the design process;
   3. complete itemized list of materials; and
   4. prepare working drawings using standard symbols and conventions.

C. Concepts and skills related to evaluating products and services of technology. The student shall be provided opportunities to:
   1. recognize good design and construction;
   2. practice evaluation of products based on given standards or applications;
   3. practice the servicing of industrial products and equipment;
   4. develop criteria for selecting, purchasing, and contracting services; and
   5. relate wise consumer choices to the free enterprise system.

D. Leadership concepts and skills. The student shall be provided opportunities to:
   1. identify characteristics and responsibilities of leaders and effective group members;
   2. participate in orderly meetings conducted according to parliamentary procedure (optional to occupational orientation);

3. function effectively on committees (optional in occupational orientation);
4. plan and conduct leadership activities; and
5. prepare for effective citizenship and participation in our democratic society.

E. Concepts and skills related to successful employment. The student shall be provided opportunities to:
1. develop an awareness of employment opportunities in chosen field;
2. practice correct procedures for job application and interview;
3. develop the ability to take and follow both oral and written directions;
4. practice punctuality and dependability;
5. observe rules and standards of the work place;
6. demonstrate an ability to work with others harmoniously;
7. develop responsibility and the ability to follow through on assigned tasks; and
8. exhibit productive work habits and attitudes.

F. Concepts and skills associated with entrepreneurship. The student shall be provided opportunities to:
1. recognize opportunities and options for business ownership;
2. identify entry-level procedures, planning processes, and terms needed to open a business; and
3. develop an understanding of the role of small business in the free enterprise system.

G. Concepts and skills involving the tools, materials, and processes used in technology. The student shall be provided opportunities to:
1. become proficient in the use of applicable tools, machines, and equipment;
2. understand the properties of a wide range of industrial materials through testing;
3. gain familiarity with the processes of various technologies; and
4. practice conservation and recycling of industrial materials.

II. Every school offering General Industrial Technology shall provide the above common core essential elements and the following essential elements.

A. Concepts and skills related to visual communication technology. The student shall be provided opportunities to:
1. make freehand technical drawings;

2. apply accepted lettering practices and styles;
3. construct multiview projections with instruments;
4. describe object size by standard dimensioning practice;
5. describe objects through pictorial methods;
6. apply design principles to composition and layout techniques;
7. operate standard reproduction and duplicating equipment;
8. use standard finishing techniques;
9. produce products using accepted methods of image generation;
10. study the types and uses of visual communication equipment;
11. use computer software to design and make drawings;
12. explore the use of function codes in computer numerical control of production machines; and
13. use data base software to assist in collecting, storing, retrieving, and applying information for industrial applications.

B. Concepts and skills related to energy technology. The student shall be provided opportunities to:
1. use apparatus and devices that demonstrate the generation, conversion, and control of mechanical, electrical, and pneumatic-hydraulic power;
2. construct static or working models or examples of devices that generate, convert, or control energy;
3. utilize computers for the collection and analysis of data relevant to energy technology;
4. compare transportation systems that move people and materials by land, sea, air, and space;
5. plan and implement the controlled movement of robots;
6. use instrumentation with computers to monitor data-based systems;
7. compare transmission systems that move energy by electrical, electronic, mechanical, and pneumatic-hydraulic technologies;
8. construct static or working models that demonstrate devices or systems used to move people and materials;

9. construct static or working models that demonstrate devices or systems that transmit energy; and
10. read and interpret maps, charts, and schedules.

C. Concepts and skills related to production technology. The student shall be provided opportunities to:
1. apply industrial organization and management systems by planning, organizing, and controlling production processes;
2. apply primary industrial processes of layout, testing, separating and cutting, drilling and boring, shaping and forming, casting, laminating, coating, decorating, joining, and finishing;
3. research the recycling of industrial materials;
4. plan and implement the various steps in the construction process;
5. research the transformation of raw materials into finished products;
6. plan and implement mass production activities;
7. demonstrate techniques and processes used in automated production systems; and
8. use computers in planning, production, quality control, and management of production systems.

APPENDIX J

Essential Elements for Industrial Technology

I. Each of the courses offered should cover all of the following common essential elements.

A. Concepts and skills in the application of safety procedures. The student shall be provided opportunities to:
   1. demonstrate safe operation of selected tools and equipment;
   2. maintain safe conditions in laboratories; and
   3. evaluate laboratories and facilities for unsafe conditions.

B. Concepts and skills in planning, designing, and problem solving. The student shall be provided opportunities to:
   1. plan and design industrial products of the student's choice;
   2. apply problem-solving techniques to the design process;
   3. complete itemized list of materials; and
   4. prepare working drawings using standard symbols and conventions.

C. Concepts and skills related to evaluating products and services of technology. The student shall be provided opportunities to:
   1. recognize good design and construction;
   2. practice evaluation of products based on given standards or applications;
   3. practice the servicing of industrial products and equipment;
   4. develop criteria for selecting, purchasing, and contracting services; and
   5. relate wise consumer choices to the free enterprise system.

D. Leadership concepts and skills. The student shall be provided opportunities to
   1. identify characteristics and responsibilities of leaders and effective group members;
   2. participate in orderly meetings conducted according to parliamentary procedure (optional to occupational orientation);
   3. function effectively on committees (optional in occupational orientation);
   4. plan and conduct leadership activities; and
   5. prepare for effective citizenship and participation in our democratic society.

E. Concepts and skills related to successful employment. The student shall be provided opportunities to:
   1. develop an awareness of employment opportunities in chosen field;
   2. practice correct procedures for job application and interview;

3. develop the ability to take and follow both oral and written directions;
4. practice punctuality and dependability;
5. observe rules and standards of the work place;
6. demonstrate an ability to work with others harmoniously;
7. develop responsibility and the ability to follow through on assigned tasks; and
8. exhibit productive work habits and attitudes.

F. Concepts and skills associated with entrepreneurship. The student shall be provided opportunities to:
1. recognize opportunities and options for business ownership;
2. identify entry-level procedures, planning processes, and terms needed to open a business; and
3. develop an understanding of the role of small business in the free enterprise system.

G. Concepts and skills involving the tools, materials, and processes used in technology. The student shall be provided opportunities to:
1. become proficient in the use of applicable tools, machines, and equipment;
2. understand the properties of a wide range of industrial materials through testing;
3. gain familiarity with the processes of various technologies; and
4. practice conservation and recycling of industrial materials.

II. Industrial Technology courses, grades 9-12, cover specific topics of study at general and advanced levels in each of the three technologies.

A. General Drafting (Visual Communication Technology - 1/2-1 unit) shall include the essential elements common to all Industrial Technology and the following essential elements and concepts and skills related to General Drafting. The student shall be provided opportunities to:
1. use American National Standards Institute symbols and conventions;
2. demonstrate freehand sketching techniques;
3. apply accepted lettering practices and styles;
4. understand the relationship between points, lines, and planes through multiview drawing principles;
5. describe objects adequately through the principles of shape and size description;

6. describe objects through various pictorial development techniques;
7. apply drawing techniques suitable for reproduction;
8. apply the concepts of residential building design and technical drafting;
9. understand the use of the computer in designing and making working drawings; and
10. use drawing reproduction equipment.

B. Engineering Graphics (Visual Communications Technology - 1/2-1 unit) shall include the essential elements common to all Industrial Technology and the following essential elements and concepts and skills related to Engineering Graphics. The student shall be provided opportunities to:
1. apply sketching techniques to develop drawing format and graphic problem solving;
2. demonstrate orthographic projection techniques using advanced applications;
3. select appropriate drafting conventions to describe object shape;
4. apply descriptive geometry principles in developing revolution, auxiliary and successive auxiliary drawings;
5. produce working drawings of single and multi-part mechanical devices;
6. demonstrate the drawing of isometric, oblique, and perspective drawings;
7. use standard parts charts and tables;
8. apply the principles of advanced size description relating to tolerance and precision dimensioning;
9. understand the principles of threads and fasteners and their symbolic application;
10. understand the use of the computer for designing, plotting, and engineering manufactured products; and
11. use drawing reproduction equipment.

C. Technical Drafting/Advanced Technical Drafting (Visual Communication Technology - 1/2-1 unit) shall include the essential elements common to all Industrial Technology and the following essential elements:
1. Concepts and skills related to Technical Drafting. The student shall be provided opportunities to:
   a. use American National Standards Institute symbols and conventions;
   b. understand the use of appropriate techniques and symbols common to selected technical drawing fields such as machine, structural welding,

electrical and electronic, piping, topographical, computer-aided drafting, drafting for numerical control, technical illustration, gears and cams, developments, and jigs and fixtures;

c. use selected charts and tables for making drawings;

d. apply sketching techniques to develop drawing format and graphic problem solving;

e. describe layout and assembly of systems function using appropriate pictorial drawings; and

f. use drawing reproduction equipment.

2. Concepts and skills relating to several areas of Technical Drafting and Advanced Technical Drafting. The student shall be provided opportunities to:

a. develop production drawings in up to four of the following areas:

1) machine tools and parts,
2) structural steel,
3) welding,
4) electrical and electronics,
5) piping,
6) topographical,
7) computer-aided drafting,
8) drafting for numerical control,
9) gears and cams,
10) developments, and
11) jigs and fixtures;

b. apply sketching, projection, and rendering techniques to produce technical illustrations; and

c. understand the use of the computer for designing, plotting, and engineering manufactured products.

D. Architectural Drafting/Advanced Architectural Drafting (Visual Communication Technology - 1/2-1 unit) shall include the essential elements common to all Industrial Technology and the following essential elements and concepts and skills related to Architectural Drafting. The student shall be provided opportunities to:

1. use symbols, lettering, and building standards as published by the American Institute of Architects;
2. understand minimum standards established by local and state building codes;
3. select building materials;
4. identify types of building construction;
5. investigate basic housing styles;
6. apply energy conservation practices;

7. incorporate building safety and security measures into design;
8. differentiate between residential/commercial and light/heavy construction;
9. understand the use of the computer in designing, making working drawings, writing specifications, developing cost estimates, and managing construction;
10. use architectural symbols and procedures to draw floor plans, elevations, foundation plans, plot plans, wall sections and details;
11. apply design and planning principles to develop floor plan arrangement;
12. apply technical illustration techniques to produce presentation drawings;
13. develop schedules and written specifications; and
14. use drawing reproduction equipment.

E. General Photography/Advanced Photography (Visual Communication Technology - 1/2-1 unit) shall include the essential elements common to all Industrial Technology and the following essential elements and concepts and skills in Photography. The student shall be provided opportunities to:
1. define the nomenclature of camera systems;
2. apply principles of optics and light control;
3. use artificial lighting techniques;
4. demonstrate chemical preparation procedures;
5. understand the principles of video, computer-generated images, and other photographic media;
6. apply composition techniques in pictures;
7. understand computer-assisted camera techniques;
8. produce black and white negatives and prints;
9. produce color negatives and prints;
10. produce color transparencies;
11. evaluate photographic work; and
12. display photographic work.

F. General Graphic Arts/Advanced Graphic Arts (Visual Communication Technology - 1/2-1 unit) shall include the essential elements common to all Industrial Technology and the following essential elements and concepts and skills in Graphic Arts. The student shall be provided opportunities to:*
1. use common type styles;
2. apply design principles;

3. prepare layout and copy for reproduction processes;
4. operate mechanical and photographic equipment used in typesetting;
5. process photographic materials;
6. use proper exposure and darkroom procedures;
7. apply appropriate platemaking procedures;
8. operate lithographic printing equipment;
9. describe relief printing equipment;
10. describe gravure reproductions;
11. use screen printing processes;
12. use duplicators and copiers;
13. apply finishing and binding methods;
14. use various types of paper and ink used in printing;
15. estimate job costs; and
16. describe legal restrictions and copyright laws on reproductions.

G. General Computer Applications (Visual Communication Technology - 1/2-1 unit) shall include the essential elements common to all Industrial Technology and the following essential elements and concepts and skills in Computer Applications. The student shall be provided opportunities to:*

1. become aware of the many uses of computers in industry;
2. describe the need for different computer languages used in industry;
3. use different types of input/output devices to simulate those used in industry;
4. control movements of robotic components;
5. simulate the use of robots to control industrial processes;
6. study the function codes of computer numerical control;
7. use computer numerical controlled machines to produce industrial products;
8. use computer-aided drafting to make working drawings;
9. simulate the use of computer-aided manufacturing to plan, produce, control, and manage manufacturing processes;
10. use computer image generation methods to communicate information;
11. use data base software to assist in collecting, storing, retrieving, and applying information for industrial applications;
12. use industrial simulation and modeling to solve problems; and
13. study future uses of computers in industry.

H. Individual Problems in Visual Communication Technology (1/2-1 unit) shall include the essential elements common to Industrial Technology and the following essential elements and concepts and skills of Individual Problems. The student shall be provided opportunities to:*
   1. identify a technological problem for individual study;
   2. review literature related to the selected problem;
   3. conduct a study by investigating alternative solutions; and
   4. report findings and conclusions.

I. General Power Systems/Advanced Power Systems (Energy Technology - 1/2-1 unit) shall include the essential elements common to all Industrial Technology and the following essential elements and concepts and skills related to Power Systems. The student shall be provided opportunities to:
   1. understand the history of power systems;
   2. understand the development of power systems with the social and industrial implications;
   3. investigate and apply principles of generation, conversion, transmission, and control and use of mechanical and fluid power;
   4. investigate the use of computers to monitor and control power systems;
   5. experiment with internal and external combustion engines;
   6. analyze and experiment with mechanical applications to distribute and utilize power;
   7. test pneumatic and hydraulic control systems;
   8. determine efficiency and output of power systems; and
   9. recognize environment relationships of power systems.

J. General Electrical Systems/Advanced Electrical Systems (Energy Technology - 1/2-1 unit) shall include the essential elements common to all Industrial Technology and the following essential elements and concepts and skills dealing with Electrical Systems. The student shall be provided opportunities to:
   1. apply the use of electricity and electronics laws and principles;
   2. investigate atomic theory, sources of electricity, current flow, magnetism, theory and use of meters, simple circuits, simple DC and AC motors, and residential wiring;

3. demonstrate the use of vacuum tubes, power supplies, amplifiers, oscillators, transmitters, electromatic radiation, receivers, and semiconductors;
4. apply electrical practices involved in storage systems;
5. investigate electromagnetic systems;
6. understand electro-mechanical systems;
7. understand microwave laser systems;
8. investigate the utilization of generators and transformers;
9. understand the use of computerized circuit controls and program controls;
10. describe solid state electronics;
11. survey the mini-component electronic systems;
12. apply radio and television communication principles;
13. understand single phase and three-phase concepts; and
14. investigate security and detector systems provided by electronic industry.

K. General Transportation/Advanced Transportation Systems (Energy Technology - 1/2-1 unit) shall include the essential elements common to all Industrial Technology and the following essential elements and concepts and skills related to Transportation Systems. The student shall be provided opportunities to:*

1. review the history of transportation and the past, present, and future influences upon society;
2. analyze the advantages, disadvantages, and limitations of various modes of transportation;
3. analyze the functions of transportation systems in respect to the movement of goods and people;
4. examine the components of transportation systems including computer controls and automated scheduling systems;
5. compare transportation systems that utilize electrical, electronic, mechanical, or fluid technologies;
6. prepare static or working energy transmission and/or conversion models that demonstrate such processes or their instrumentation and control;
7. develop static or working models that demonstrate devices or systems used to move people and materials;
8. utilize computers to collect and analyze data relevant to transportation systems;

9. design and control robotic components of transportation systems;
10. investigate the problems of pollution associated with various forms of transportation;
11. study the sociocultural implications associated with transportation systems of the future;
12. review the international, national, state, and local rules and regulations which control transportation systems;
13. investigate the relationship between transportation, communication, and production;
14. investigate mass transportation;
15. read and interpret maps, charts, and schedules; and
16. study additional support systems which serve the transportation industries.

L. General Energy/Alternate Energy Systems (Energy Technology - 1/2-1 unit) shall include the essential elements common to Industrial Technology and the following essential elements and concepts and skills related to Energy Systems. The student shall be provided opportunities to:*
1. demonstrate the conversion, instrumentation, and control of energy through the exploration of energy conversion and storage;
2. manipulate apparatus and devices that demonstrate the conversion, storage, and control of the basic forms of energy;
3. construct static or working models or examples of devices that generate, convert, or control energy;
4. utilize computers to interface instrumentation for monitoring and controlling energy systems;
5. investigate and predict ecological and conservation problems associated with energy generation and conversion using historical and demographic data;
6. analyze the advantages, disadvantages, and limitations of various types of contemporary and alternative energy systems;
7. review the international, national, state, and local rules and regulations which control energy generation and conversion systems; and
8. utilize robotic and automated devices to control and monitor energy systems.

M. Individual Problems in Energy Technology (1/2-1 unit) shall include the essential elements common to Industrial Technology and the following essential elements and concepts and skills of Individual Problems. The student shall be provided opportunities to:*

1. identify a technological problem for individual study;
2. review literature related to the selected problem;
3. conduct a study by investigating alternative solutions; and
4. report findings and conclusions.

N. General Construction Processes (Production Technology - 1/2-1 unit) shall include the essential elements common to all Industrial Technology and the following essential elements and concepts and skills of Construction. The student shall be provided opportunities to:*

1. develop an awareness of construction as one of the largest industries in the U.S. and its relationship to the local, state, and national economy;
2. describe the relationships between management and labor as it relates to the construction of a product;
3. identify materials used in common structures with emphasis on new materials and new construction methods;
4. compare the different types of structures and the effects they have upon man's environment and the future;
5. describe the relationship of capital, management, personnel, and processes in construction;
6. plan, organize, and construct a structure;
7. apply the basic principles of foundation, wall, and roof structures;
8. plan and install utilities;
9. use construction terminology correctly;
10. research the historical developments in construction as a basis for analyzing and predicting future construction trends;
11. practice finishing techniques in construction;
12. analyze and perform servicing and maintenance procedures of structures;
13. research, design, and construct alternative energy systems for new and existing structures;
14. explain how construction meets human needs and its impact on the future;

15. research the financing of homes under current mortgage conditions;
16. discuss local, state, and national building code requirements;
17. investigate the principles of supply and demand;
18. plan the efficient use and reuse of materials;
19. analyze the social, personal, and ecological effects of cost/benefit decision making;
20. demonstrate problem-solving techniques in the selection of suitable materials and processes for constructing structures; and
21. develop positive attitudes regarding the value and dignity of work.

O. General Manufacturing Processes (Production Technology - 1/2-1 unit) shall include the essential elements common to all Industrial Technology and the following essential elements and concepts and skills of Manufacturing. The student shall be provided opportunities to:*
1. develop an awareness of manufacturing as one of the largest industries in the U.S. and its relationship to the local, state, and national economy;
2. investigate the interrelationship of business, labor, and investors in the economic system;
3. investigate the source, nature, application, and the relationship of materials used in manufacturing;
4. identify the different methods of separating, forming, machining, integrating, assembling, and finishing materials;
5. describe the relationship of capital, management, personnel, and processes in manufacturing;
6. research, design, engineer, produce, market, and service products;
7. use manufacturing terminology correctly;
8. research historical development of manufacturing as a basis for analyzing and predicting future manufacturing trends;
9. design functional manufacturing facilities to produce a functional product in a cost/effective manner;
10. investigate the industrial processes employed to fabricate manufacturing materials into functional items;
11. demonstrate problem-solving techniques in the selection of suitable materials and processes for fabricating various products;

12. operate management systems as used in manufacturing;
13. explain the principles of supply and demand;
14. explore the advantages and disadvantages of specialization to increase efficiency of production and services;
15. explore application of automated manufacturing systems;
16. plan the efficient use and reuse of materials;
17. analyze the social, personal, and ecological effects of cost/benefit decision making;
18. distinguish between collectivism and the free enterprise system;
19. analyze industrial materials on the ecological balance, the utilization and conservation of natural resources, and the recycling capabilities of industrial materials and products;
20. distinguish the important differences between American manufacturing technology and the manufacturing technology of other leading industrial nations;
21. evaluate the effects of high technology on manufacturing systems;
22. integrate high technology systems into manufacturing and mass production activities; and
23. develop positive attitudes regarding the value and dignity of work.

P. General Woodworking/Advanced Woodworking (Production Technology - 1/2-1 unit) shall include the essential elements common to all Industrial Technology and the following essential elements and concepts and skills related to Woodworking. The student shall be provided opportunities to:
1. apply the industrial processes of material testing, planning, designing, fabricating, finishing, repairing, and refinishing;
2. select construction materials best suited to a given application;
3. transform raw materials into finished products;
4. apply mass production techniques;
5. demonstrate knowledge and skills in the use of hardware, fasteners, jointery, and adhesives;
6. understand techniques and processes used in automated production systems;
7. identify synthetic materials and exotic materials used for furniture and cabinetmaking;

8. investigate industrial tools, materials, and processes common to the construction, furniture, and cabinetmaking industries; and
9. understand the use of the computer and robots in manufacturing wood products.

Q. General Metalworking/Advanced Metalworking (Production Technology - 1/2-1 unit) shall include the essential elements common to all Industrial Technology and the following essential elements and concepts and skills of Metalworking. The student shall be provided opportunities to:
1. develop basic skills in four or more of the following areas:
   a. bench and wrought metal,
   b. machining,
   c. welding,
   d. foundry,
   e. forging and metallurgy,
   f. sheetmetal, and
   g. metal spinning;
2. investigate the industrial processes of metal coating;
3. practice metalworking skills and techniques for fabricating, forming, shaping, fastening, bending, cutting, drilling, turning, and finishing;
4. research powdered metal technology;
5. understand the oxidation of metals;
6. apply mass production techniques;
7. understand the properties and characteristics of metals; and
8. understand the use of the computer and robots in manufacturing metal products.

R. General Plastics/Advanced Plastics (Production Technology - 1/2-1 unit) shall include the essential elements common to all Industrial Technology and the following essential elements and concepts and skills related to Plastics. The student shall be provided opportunities to:
1. apply basic principles to molding, forming, mold making, bonding, laminating, encapsulating, foams, coating, vinyl dispersion, decorating, and thermofusion;
2. practice mold making using silicone, urethane, latex, and epoxy;
3. fabricate with chemicals, hot air, and heat sealing techniques;
4. laminate with pressurized systems;
5. apply machining techniques;
6. use and maintain tools unique to the plastics industry;
7. apply mass production techniques; and

8. understand the use of the computer and robots in manufacturing plastics products.

S. Individual Problems in Production Technology (1/2-1 unit) shall include the essential elements common to Industrial Technology and the following essential elements and concepts and skills of Individual Problems. The student shall be provided opportunities to:*

1. identify a technological problem for individual study;
2. review literature related to the selected problem;
3. conduct a study by investigating alternative solutions; and
4. report findings and conclusions.

*Suggested essential elements not approved by the State Board of Education due to low enrollment.